PANTHER Gas Chromatograph: A Progress Report

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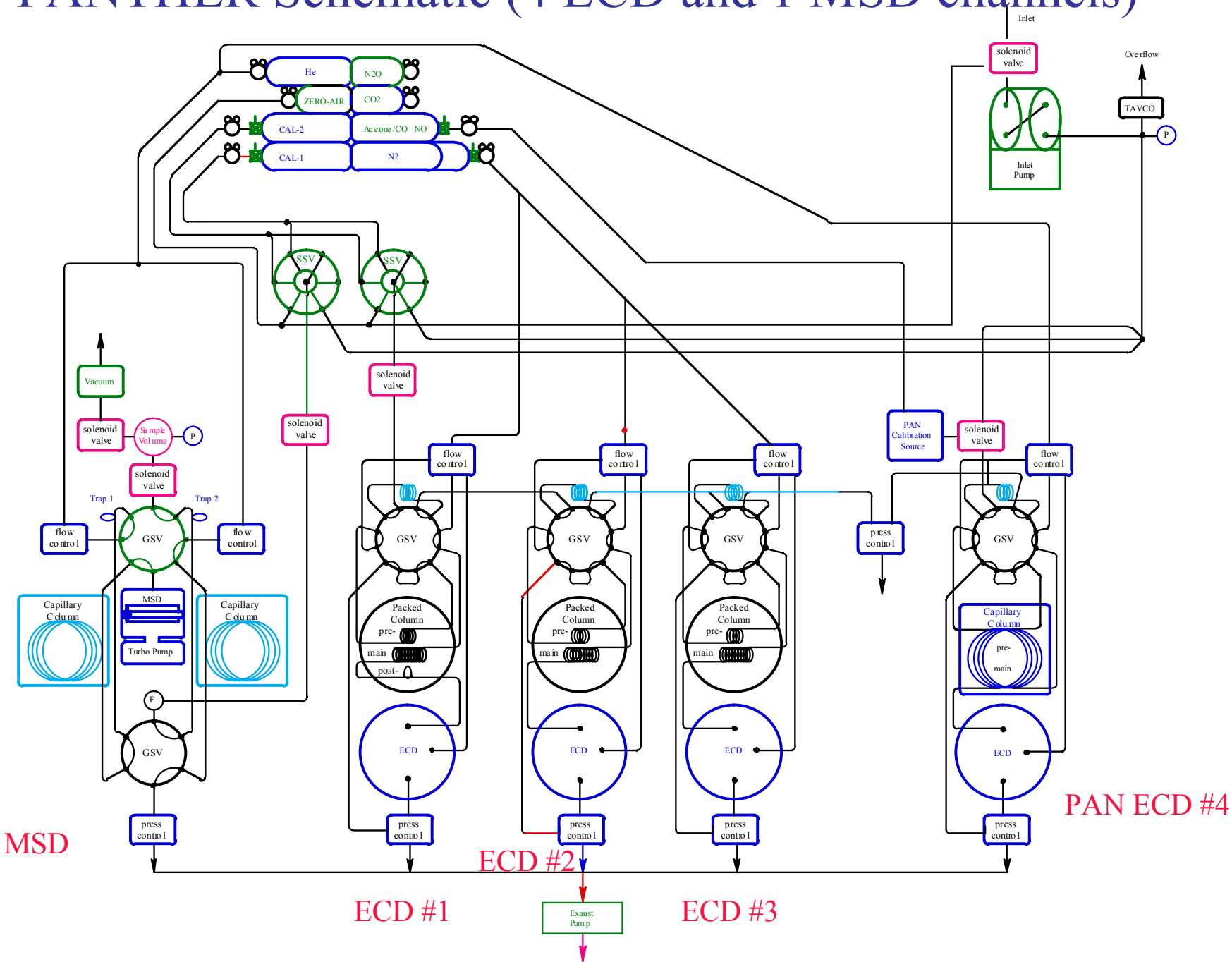
Abstract

- PAN (Peroxy Acetyl Nitrate) and other Trace Hydrohalocarbon ExpeRiment (PANTHER) is a next generation gas chromatograph (GC) capable of measuring trace gases involved in air quality, climate forcing, and stratospheric ozone depletion. It has four gas chromatograph-electron capture detector (GC-ECD) and one gas chromatograph-mass selective detector (GC-MSD) channels.
- This instrument has been integrated on the NASA ER-2, WB-57F, and DC-8 aircraft. It has flown on test flights on the WB-57F and DC-8 aircraft. It would require some modification (thermal issues) to fly on NASA balloon platforms.
- This instrument flew on its first test during the CRYSTAL-FACE mission. The flight was a successful engineering flight, but didn't lead to any science quality data.
- PANTHER flew on all SOLVE-2 test and science flights. It got science quality data on all science flights except one.
- For SOLVE-2, three electron capture detector and mass spectrometer channels were operating.

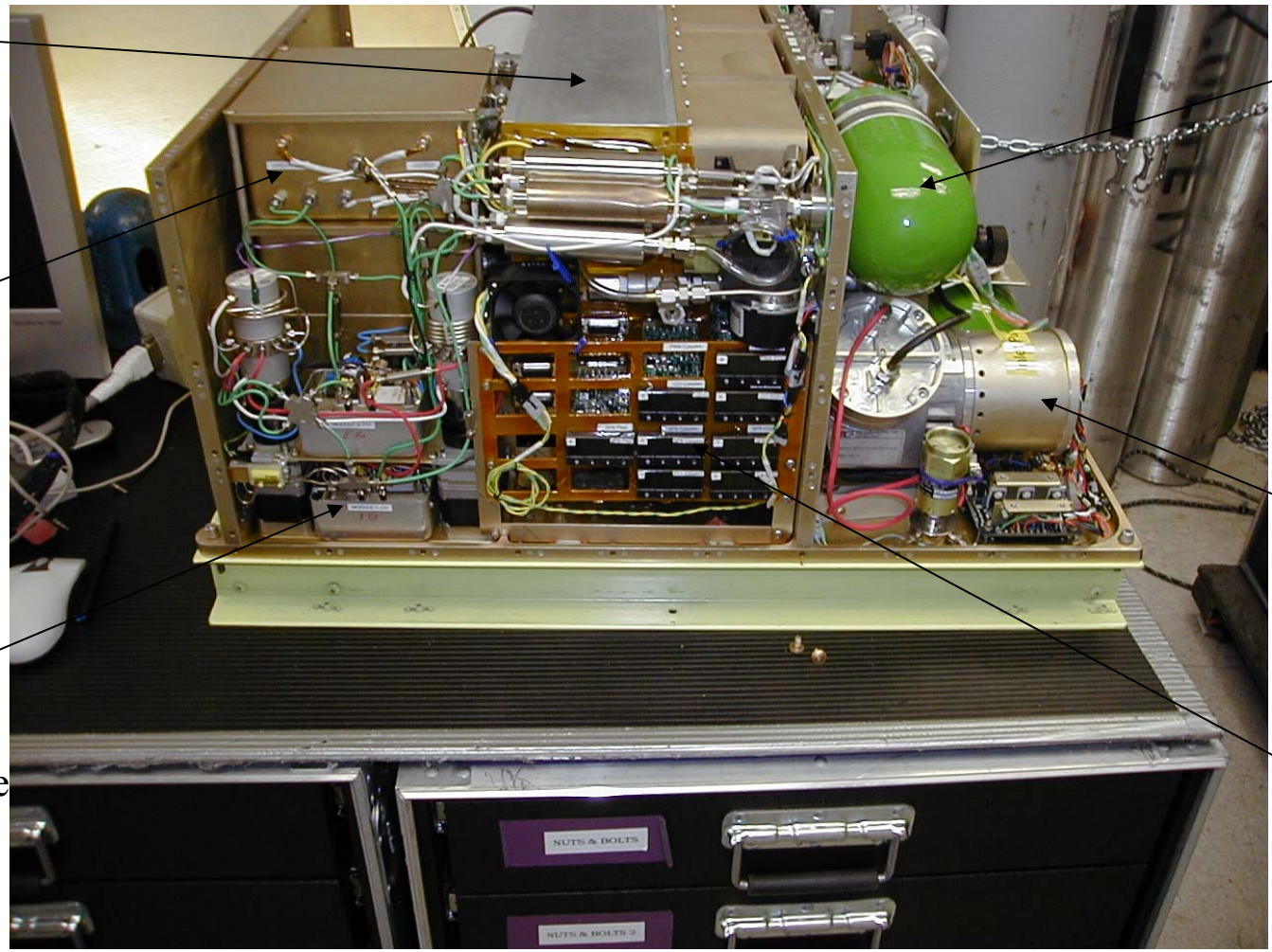
Applications: Justification of new airborne gas chromatograph for the short-lived trace gases

- Future airborne missions will focus on more atmospheric chemistry, mainly in the troposphere and lowermost stratosphere
- Ground-truth measurements for satellite- and space-borne instruments.
- Shorter lived trace gases, like hydrocarbons, organic nitrates, hydrogen substituted halocarbons (Cl and Br solvents: CH_2Cl_2, C_2Cl_4, and HFCs, HCFCs) play a major role in air pollution and climate change.
- Recent amendments to the U.S. Clean Air Act (control of Cl solvents).
- Cryogenically trap large air samples and scan for unknown trace gases.

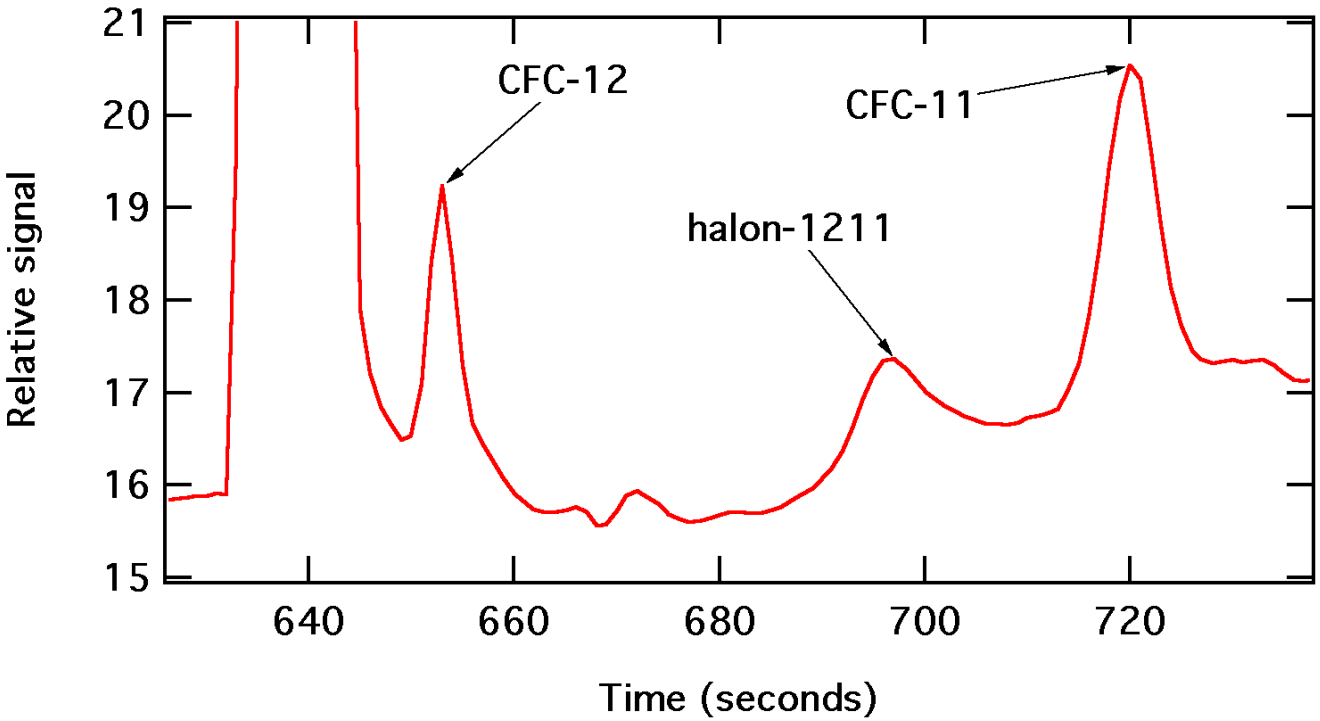
PANTHER Schematic (4 ECD and 1 MSD channels)



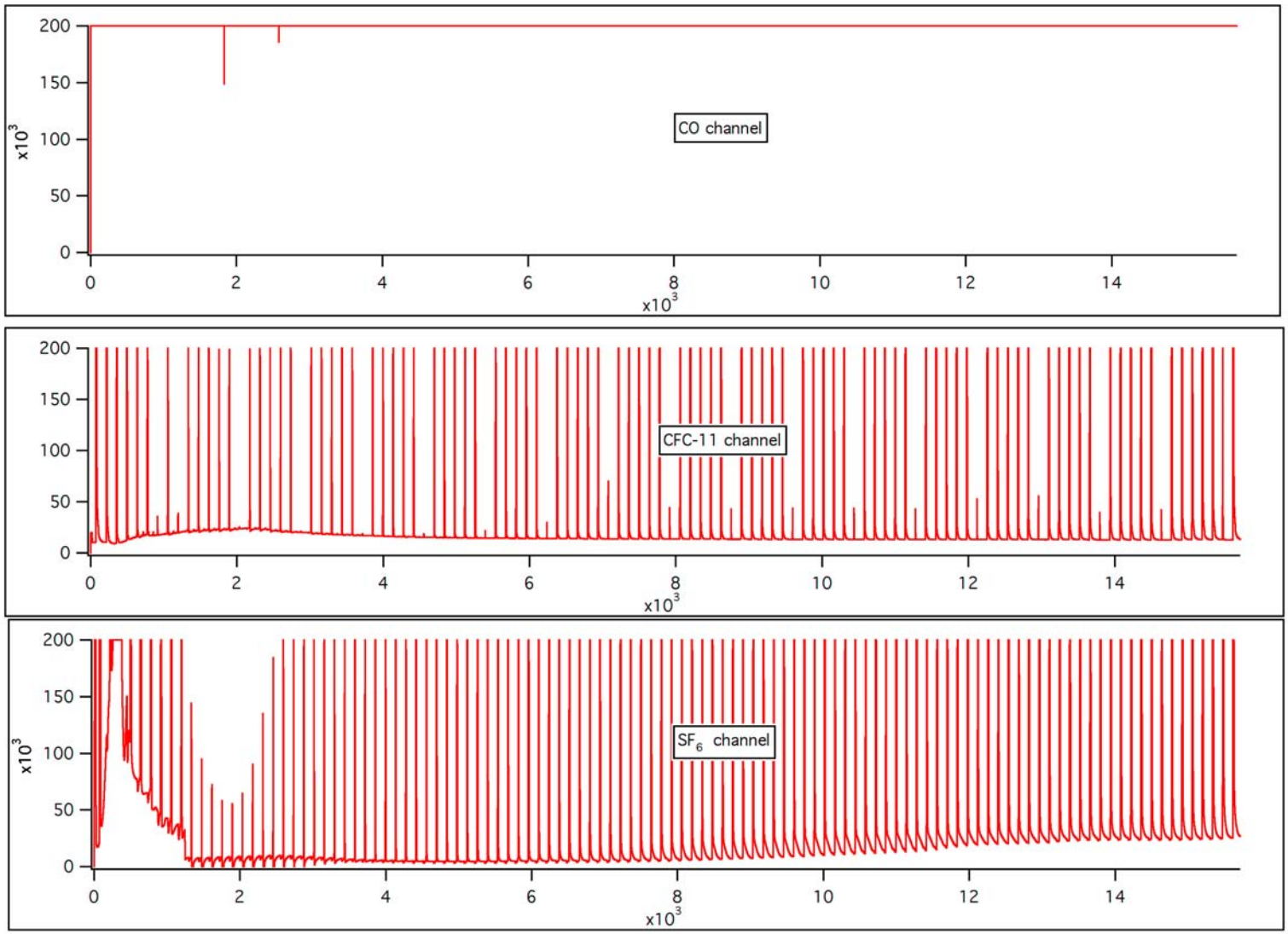
PANTHER Overview



CRYSTAL-FACE Real air signal
July 31, 2002



Test Flight Successful (July 31, 2002)



PANTHER team participates in SOLVE-2 at NASA Dryden & Kiruna, Sweden on DC-8

Jim Elkins & Fred Moore in front of DC-8.

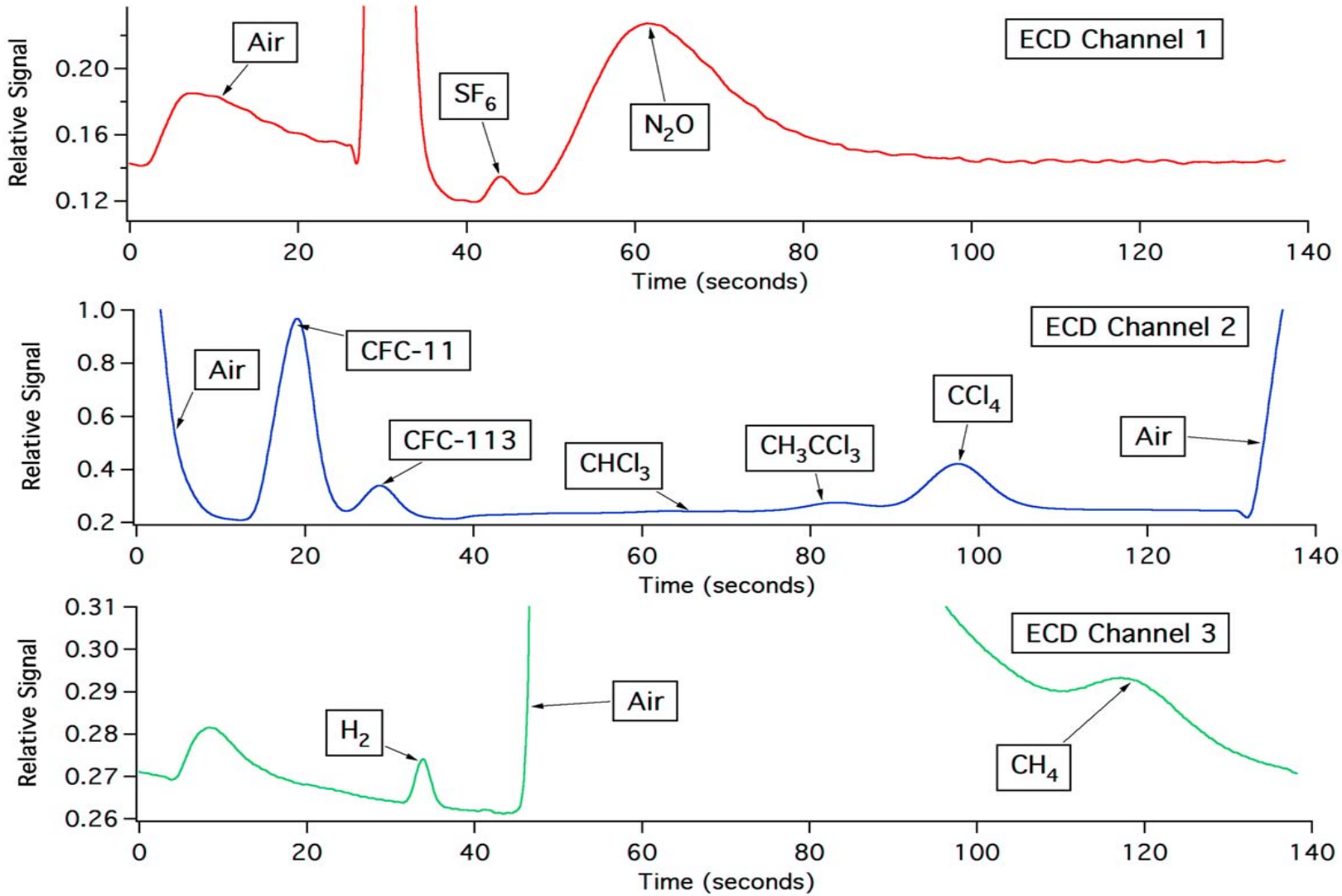
PANTHER's inlet on DC-8.

Fred Moore running PANTHER on DC-8.

PSCs outside hangar on January 11, 2003.

Instrument Details: Station 5 on NASA DC-8 aircraft, 200 lbs., 24" w x 28" l x 15" h, 1 kw (2 kw peak)

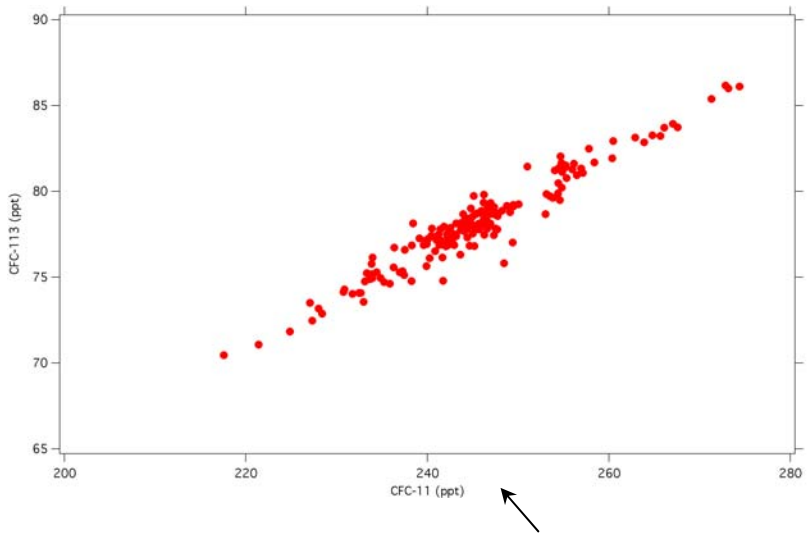
PANTHER ECD Chromatograms during SOLVE-2



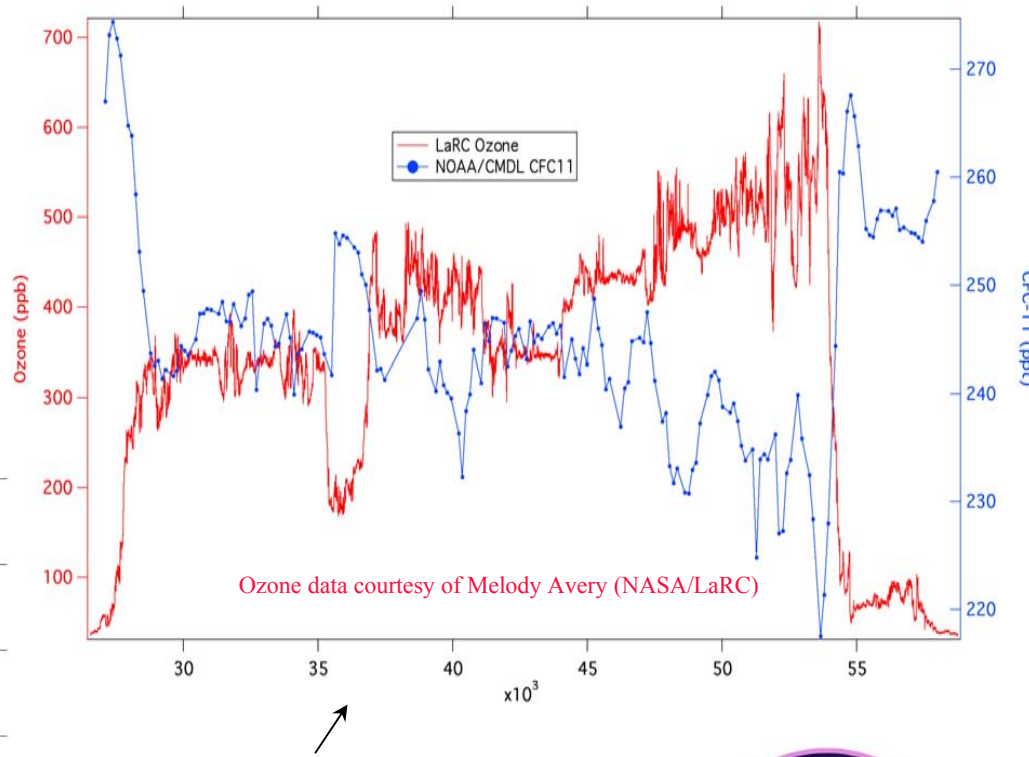
NOAA/CMDL PANTHER GC on NASA DC-8

January 19, 2003

- ECD channels- CFC-11, CFC-113, $CHCl_3$, CH_3CCl_3, CCl_4, CH_4, H_2, N_2O, SF_6
- Mass Spectrometer channel: CH_3Cl, CH_3Br, HCFC-22, COS, HCFC-142b, CFC-12, HFC-134a



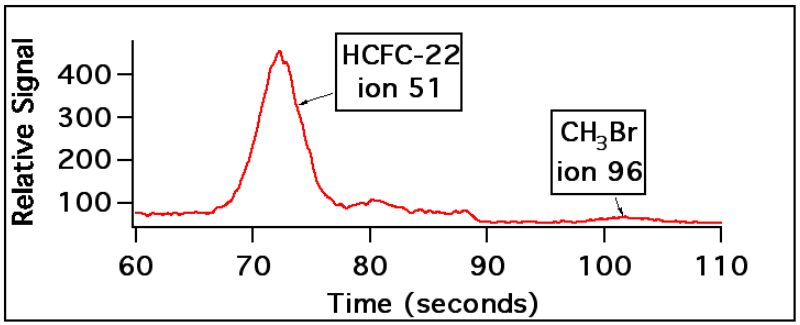
Tight correlation of source gases.

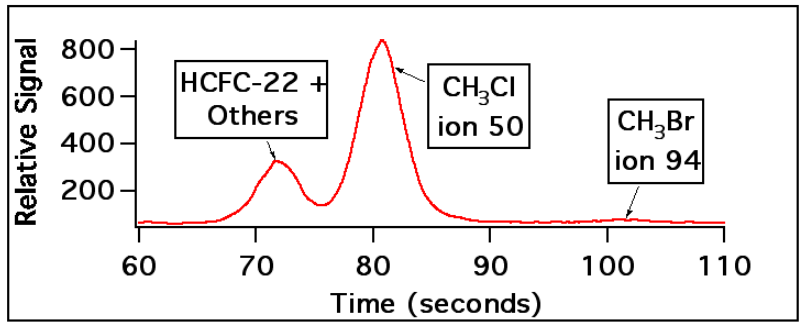


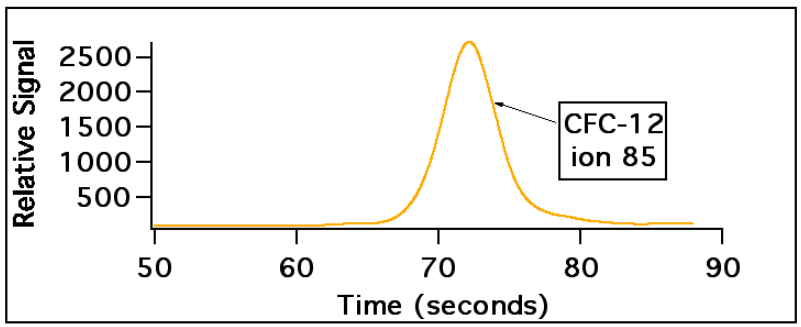
Inverse relationship of CFC-11 Versus ozone (O_3).

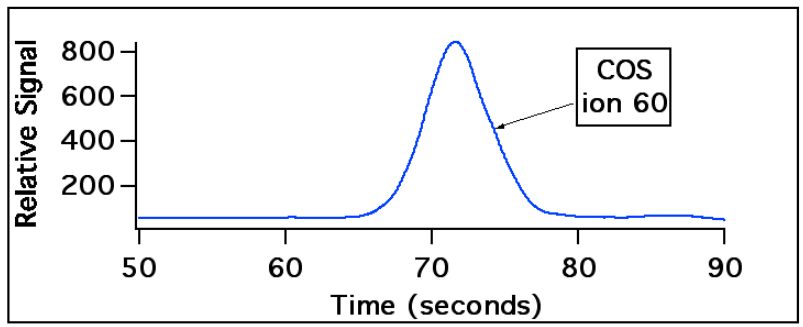
SOLVE II
SAGE III Ozone Loss Validation Experiment

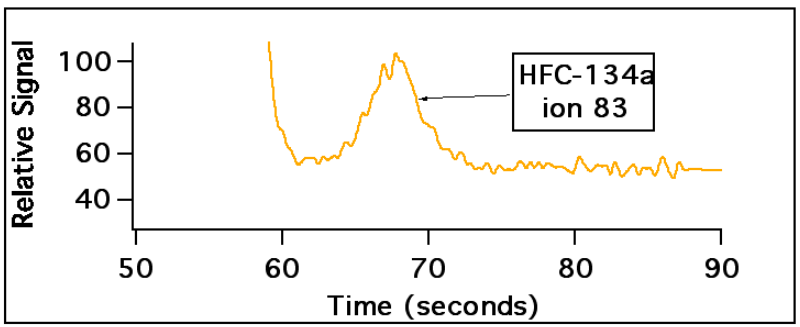
PANTHER MSD Chromatograms

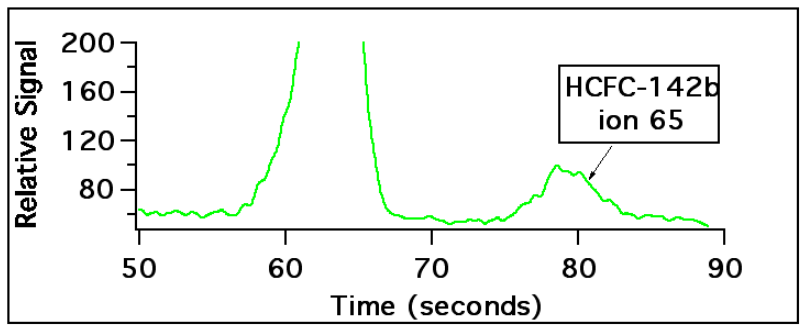




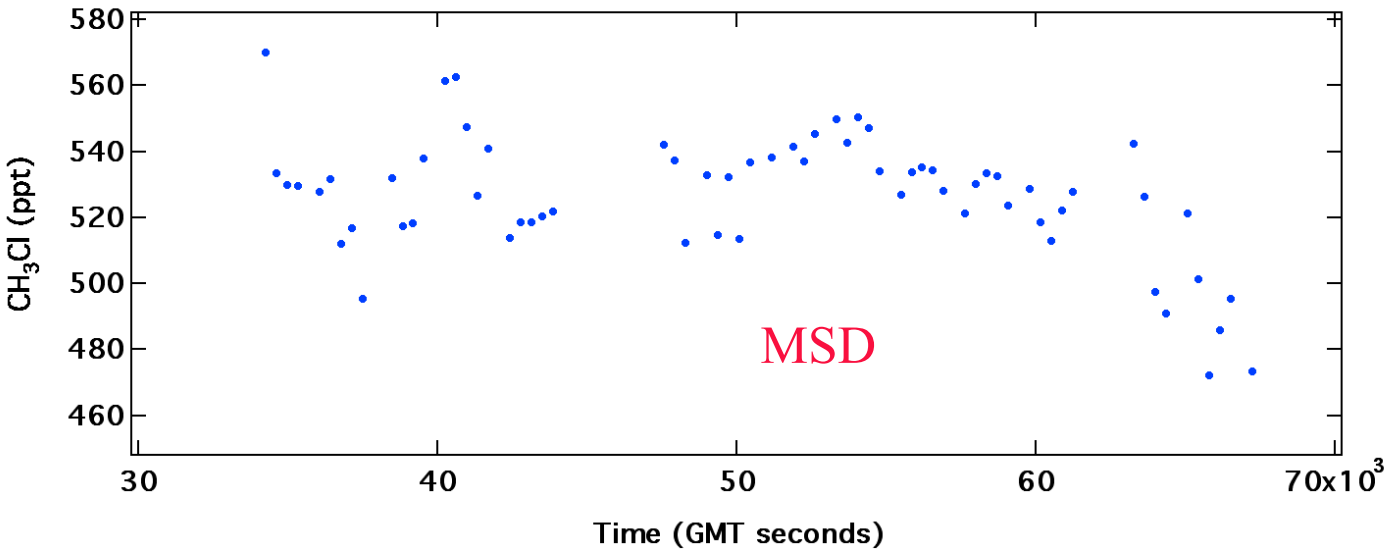


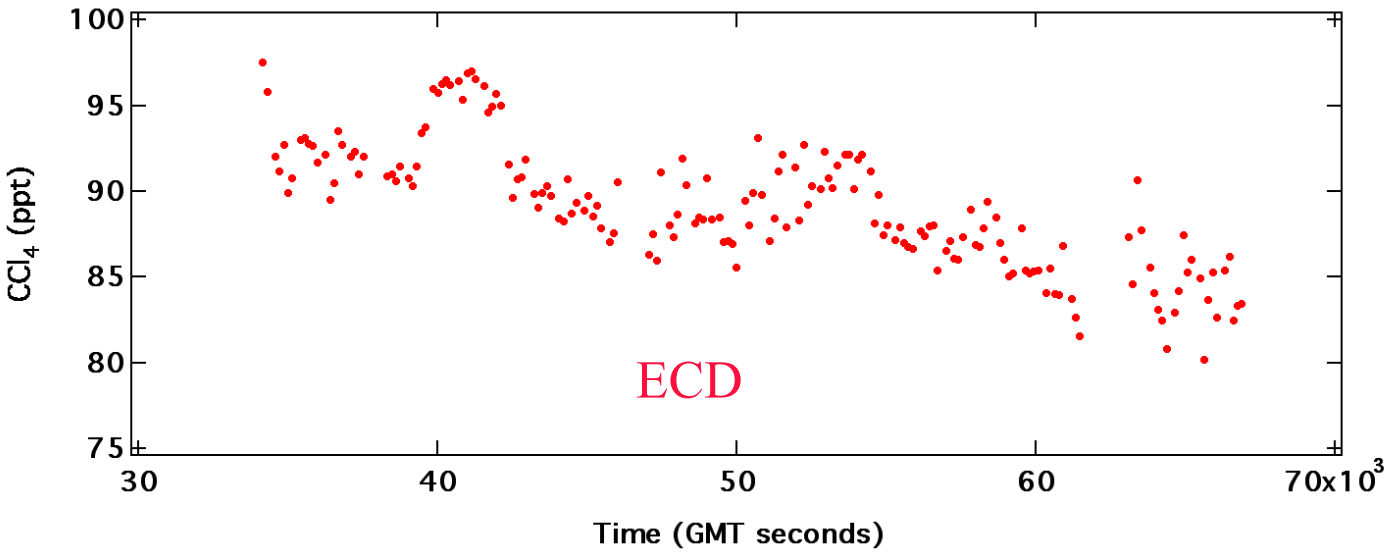






First *in situ* Measurements of methyl chloride (CH_3Cl) January 24, 2003





Data are preliminary.